

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of claims:

1-19. (Canceled)

20. (New) A power output apparatus that outputs power to a drive shaft, said power output apparatus comprising:

an internal combustion engine;

a three-shaft power input-output assembly that is connected with three shafts, that is, an output shaft of said internal combustion engine, said drive shaft, and a third shaft, and specifies input and output of power from and to one residual shaft among said three shafts, based on powers input and output from and to two shafts among said three shafts;

a generator that inputs and outputs power from and to said third shaft;

a motor that is capable of inputting and outputting power from and to said drive shaft;

an accumulator that is capable of supplying and receiving electric power to and from said generator and said motor;

an input-output restriction setting module that sets an input restriction and an output restriction of said accumulator using watts as its unit;

a torque demand setting module that sets a torque demand required for said drive shaft in response to an operator's manipulation;

a target value setting module that sets a target rotation speed and a target torque of said internal combustion engine by applying a sum of a power demand required for outputting set torque demand to said drive shaft, a charge-discharge power demand required for charging and discharging of said accumulator and a loss to a driving line as an operating restriction of said internal combustion engine set in advance to efficiently operate said internal combustion engine;

an upper and lower limits of torque setting module that sets an upper and lower limits of torque based on that the sum of the product of a rotation speed of said generator and the upper and lower limits of torque output from said generator, a motor electric power demand to be input to and output from said motor, and auxiliary machinery electric power to be supplied from said

accumulator to auxiliary machinery and a loss of the apparatus is equal to set input-output restriction;

an upper limit variation and lower limit variation setting module that sets upper limit variation and lower limit variation, wherein an increase and decrease amount of rotation speed of said internal combustion engine is set as said upper limit variation and lower limit variation, and the increase and decrease amount of rotation speed of said internal combustion engine is obtained by applying set upper and lower limits of torque to a relational expression for control used when controlling a rotation speed of said internal combustion engine to become set target rotation speed by adjusting a torque output from said generator;

a target rotation speed correction module that sets a true target rotation speed, wherein a rotation speed obtained by correcting set target rotation speed with a rotation speed range is set as said true target rotation speed, and said rotation speed range is obtained by applying set upper limit variation and lower limit variation to the rotation speed of said internal combustion engine;

a generator torque command setting module that sets a torque command for said generator, wherein a torque obtained by applying set target rotation speed to said relational expression for control is set as said torque command for said generator;

a motor torque command setting module that sets a torque command for said motor so that set torque demand is output to said drive shaft within the range of output restriction of set input-output restriction when said generator is driven by set torque command;

a control module that controls said generator, said motor and said internal combustion engine so that said generator is driven with a torque command set by said generator torque command setting module, said motor is driven with a torque command set by said motor torque command setting module and said internal combustion engine is driven with a driving point consisting of the target rotation speed and the target torque set by said target value setting module.

21. (New) A hybrid vehicle, comprising:

an internal combustion engine;

a three-shaft power input-output assembly that is connected with three shafts, that is, an output shaft of said internal combustion engine, a drive shaft mechanically connected to an axle, and a third shaft, and specifies input and output of power from and to one residual shaft among

said three shafts, based on powers input and output from and to two shafts among said three shafts;

a generator that inputs and outputs power from and to said third shaft;

a motor that is capable of inputting and outputting power from and to said drive shaft;

an accumulator that is capable of supplying and receiving electric power to and from said generator and said motor;

an input-output restriction setting module that sets an input restriction and an output restriction of said accumulator using watts as its unit;

a torque demand setting module that sets a torque demand required for said drive shaft in response to an operator's manipulation;

a target value setting module that sets a target rotation speed and a target torque of said internal combustion engine by applying a sum of a power demand required for outputting set torque demand to said drive shaft, a charge-discharge power demand required for charging and discharging of said accumulator and a loss to a driving line as an operating restriction of said internal combustion engine set in advance to efficiently operate said internal combustion engine;

an upper and lower limits of torque setting module that sets an upper and lower limits of torque based on that the sum of the product of a rotation speed of said generator and the upper and lower limits of torque output from said generator, a motor electric power demand to be input to and output from said motor, an auxiliary machinery electric power to be supplied from said accumulator to auxiliary machinery and a loss of the apparatus is equal to set input-output restriction;

an upper limit variation and lower limit variation setting module that sets upper limit variation and lower limit variation, wherein an increase and decrease amount of rotation speed of said internal combustion engine is set as said upper limit variation and lower limit variation, and the increase and decrease amount of rotation speed of said internal combustion engine is obtained by applying set upper and lower limits of torque to a relational expression for control used when controlling a rotation speed of said internal combustion engine to become set target rotation speed by adjusting a torque output from said generator;

a target rotation speed correction module that sets a true target rotation speed, wherein a rotation speed obtained by correcting set target rotation speed with a rotation speed range is set as said true target rotation speed, and said rotation speed range is obtained by applying set upper

limit variation and lower limit variation to the rotation speed of said internal combustion engine;

a generator torque command setting module that sets a torque command for said generator, wherein a torque obtained by applying set target rotation speed to said relational expression for control is set as said torque command for said generator;

a motor torque command setting module that sets a torque command for said motor so that set torque demand is output to said drive shaft within the range of output restriction of set input-output restriction when said generator is driven by set torque command;

a control module that controls said generator, said motor and said internal combustion engine so that said generator is driven with a torque command set by said generator torque command setting module, said motor is driven with a torque command set by said motor torque command setting module and said internal combustion engine is driven with a driving point consisting of the target rotation speed and the target torque set by said target value setting module.

22. (New) A control method of a hybrid vehicle, said hybrid vehicle comprising :
an internal combustion engine;

a three-shaft power input-output assembly that is connected with three shafts, that is, an output shaft of said internal combustion engine, a drive shaft mechanically connected to an axle, and a third shaft, and specifies input and output of power from and to one residual shaft among said three shafts, based on powers input and output from and to two shafts among said three shafts;

a generator that inputs and outputs power from and to said third shaft;

a motor that is capable of inputting and outputting power from and to said drive shaft;

an accumulator that is capable of supplying and receiving electric power to and from said generator and said motor;

said control method comprising the steps of:

(a) setting an input restriction and an output restriction of said accumulator using watts as its unit;

(b) setting a torque demand required for said drive shaft in response to an operator's manipulation;

(c) setting a target rotation speed and a target torque of said internal combustion

engine by applying a sum of a power demand required for outputting set torque demand to said drive shaft, a charge-discharge power demand required for charging and discharging of said accumulator and a loss to a driving line as an operating restriction of said internal combustion engine set in advance to efficiently operate said internal combustion engine;

(d) setting an upper and lower limits of torque based on that the sum of the product of a rotation speed of said generator and the upper and lower limits of torque output from said generator, a motor electric power demand to be input to and output from said motor, an auxiliary machinery electric power to be supplied from said accumulator to auxiliary machinery and a loss of the apparatus is equal to set input-output restriction;

(e) setting upper limit variation and lower limit variation, wherein an increase and decrease amount of rotation speed of said internal combustion engine is set as said upper limit variation and lower limit variation, and the increase and decrease amount of rotation speed of said internal combustion engine is obtained by applying set upper and lower limits of torque to a relational expression for control used when controlling a rotation speed of said internal combustion engine to become set target rotation speed by adjusting a torque output from said generator;

(f) setting a true target rotation speed, wherein a rotation speed obtained by correcting set target rotation speed with a rotation speed range is set as said true target rotation speed, and said rotation speed range is obtained by applying set upper limit variation and lower limit variation to the rotation speed of said internal combustion engine;

(g) setting a torque command for said generator, wherein a torque obtained by applying set target rotation speed to said relational expression for control is set as said torque command for said generator;

(h) setting a torque command for said motor so that set torque demand is output to said drive shaft within the range of output restriction of set input-output restriction when said generator is driven by set torque command;

(i) controlling said generator, said motor and said internal combustion engine so that said generator is driven with a torque command set by said generator torque command setting module, said motor is driven with a torque command set by said motor torque command setting module and said internal combustion engine is driven with a driving point consisting of the target rotation speed and the target torque set by said target value setting module.